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Process and device for folding and laying down a flexible web in zig-zag

Abstract

The invention relates to a process for folding and laying down a flexible web (1) consisting of a nonwoven fabric, a textile or a plastic film in zigzag, wherein the arriving web is contacted according to the zigzag layer distances, bent and then laid down in a stack (20).

The web is folded in zigzag as follows:

(a) The web, which is plane when arriving, is gripped and put against one of two opposite curved surfaces (5, 5') or surfaces (5, 5') forming an angle with respect to the arriving web and, after having covered a distance which corresponds to about half the zigzag layer distance, it is released and laid down on the stack (20).

(b) At the end of the first step, the web is again gripped at the zigzag layer distance and put against the second one of the two opposite curved surfaces (5, 5') or surfaces (5, 5') forming an angle with respect to the arriving web and, after having covered a distance which corresponds to about half the zigzag layer distance and wherein the movement is opposite to the movement in the first step, it is released and laid down on the stack (20).

Description

The invention relates to a process for folding and laying down a flexible web consisting of a nonwoven fabric, a textile or a plastic film in zigzag, wherein the arriving web is contacted according to the zigzag layer distances, a corresponding portion thereof is bent and then laid down in a stack. The invention further relates to a device for carrying out the process.

Materials such as nonwoven fabrics, textiles or plastic films are either provided in the form of a roll or in Leporello or zigzag folded form for being further processed. In many cases it is desirable that a flexible material is in a completely untensioned and relaxed state, so that winding it up is not possible, but the zigzag folded form is preferred. In the technology of material logistics, this zigzag or Leporello folded form is also called festooning.

In particular nonwoven fabrics having a low resistance to tearing, as used for hygiene articles and the like, can be transported or used better when being zigzag folded than when being wound up in a roll.

It is known that nonwoven fabrics and similar web materials are folded in zigzag by means of a pendulum arm (cf. US patent 5,087,140, in particular Figure 3). The material is first guided over a roller and, for tightening purposes, over a dancing or compensating roller and then inserted into a reciprocating arm which lays down the material in zigzag.

This device is, however, disadvantageous in that in the applicant's experience the material is laid down quite slowly, on the one hand, because the material only slides downwards through the swivel arm due to its own weight and, on the other hand, because the pendulum movement of the swivel arm must not carry out a too rapid movement change in order not to elongate or tear the material.

It is therefore an object to provide a process and a device for folding and laying down a flexible web, which does not exhibit the above-mentioned disadvantages. In particular, it should be possible to lay down the material in zigzag at a high speed and without an undesired overstressing of the material to be laid down.

This object is achieved with a process as mentioned above, said process being characterized by the following process steps:

(a) The web, which is plane when arriving, is gripped and put against one of two opposite curved surfaces or surfaces forming an angle with respect to the arriving web, wherein the axis of said surfaces extends parallel to the web, and, after having covered a distance which corresponds to about half the zigzag layer distance, it is released and laid down on the stack;

(b) At the end of the first step, the web is again gripped at the zigzag layer distance and put against the second one of the two opposite curved surfaces or surfaces forming an angle with respect to the web surface and, after having covered a distance which corresponds to about half the zigzag layer distance and wherein the movement is opposite to the movement in the first step, it is released and laid down on the stack.

In contrast to the process of US patent 5,087,140, the web, which is plane, preferably vertical, when arriving, is guided via a curved surface or a surface forming an angle with respect to the web surface and, alternately, after having covered a sufficient distance, laid down on the right and left sides. The curved surfaces are, e.g., rollers so that the surface of the roller, i.e. the curved surface, and the respective portion of the web contact each other and move in the same direction of rotation and with the same rotating velocity (the same rotating velocity vector).

The web can be gripped by means of movable grippers, wherein the curved surfaces or surfaces forming an angle with respect to the web surface only serve as support surfaces and do not move. Preferably, however, a configuration is selected in which the curved surfaces rotate as rollers and in which the web is gripped by means of grippers which rotate together with the curved surfaces and are connected in a movably held manner.

The web is preferably gripped vertically with respect to the direction of movement of the planely extending web which, as already indicated, makes use of its gravity and is therefore arranged vertically.

It is particularly advantageous that after a predetermined number of zigzag layers has been laid down, the stack can be moved and a new stapling process can start without interrupting the web. The process offers this simple possibility because under the curved surfaces or surfaces forming an angle with respect to the web surface, no specific configuration for laying down the staple is necessary.

A device for carrying out the process is preferably characterized in that the curved surfaces to which the web alternately adheres are each formed of two non-moving bodies or bodies rotating in opposite directions. The bodies rotating in opposite directions can perform a continuous or pendulum rotational movement.

The bodies are preferably rollers at the periphery of which at least one controlled gripper is arranged. However, use can also be made of non-moving surfaces which consist of surface elements forming an angle with respect to the web surface and onto which the web is forced by means of grippers.

The gripper can preferably be a controllable gripping opening which is arranged in an axis-parallel groove and which does not project from the periphery of the outer circumference of the gripper roller.

The gripping performed by the gripping opening is preferably facilitated in that the roller opposite to the gripper roller comprises a movable projection which, upon a respective rotation of the rollers, engages into the axis-parallel groove as a stuffing element and forces the web into the gripping opening. Each of the two rotating rollers preferably comprises a groove and a projection being spaced at an angle of rotation of 180° and being arranged in an opposite manner at the circumference. The projection and the gripping opening are influenced by control elements being arranged inside the roller and actuated, e.g., by means of a link motion in accordance with the position of the rollers.

A movable gripping opening, which is controlled by a curve roller rolling on a cam disk, is arranged in the groove. The projection on the opposite roller is arranged on a movable shaft and held in position by means of spring action. During the rotational movement, the projection and the material are forced into the gripping opening. The latter closes during the further rotation. Caused by the angular movement of the rollers, the projection slides out. The projection is movably held so that the device and the material are not damaged.

The stack is preferably laid down from the top to the bottom on an elevator which is adjustable as regards it height. This elevator has preferably a support surface consisting of individual prongs. At least one of the rollers has a circumference with peripheral grooves into which the prongs of the elevators can engage and disengage. It is thus possible that due to a rapid engagement of the elevator prongs into the open V of a layer of the textile web, a new stack is begun, in which the upper portion of the V lays down from the top onto the

elevator prongs, and the finished stack thereunder can be transported away by a different elevator. The two stacks remain in contact via a corresponding intermediate layer.

The two elevators can also be equipped with prongs being arranged at different distances from each other so that a staple can be changed when the prongs are interconnected.

The invention is described on the basis of working examples. The individual Figures show:

Figure 1:	a schematic view of a folding device according to the invention;
Figures 2a to 2c:	a schematic side view of different phases of the folding process;
Figures 3a to 3c:	different phases of changing the stack with running folding process;
Figures 4a to 4c:	three phases of changing the fold in a further overall view;
Figure 5:	an embodiment with a plurality of folding devices arranged in a cascade, schematically seen from the top;
Figure 6:	a roller with grooves;
Figure 7:	a schematic view of a gripper control of the rollers.

Figure 1 shows a device 100 for folding and laying down a flexible web 1 consisting of a nonwoven fabric or another softly hanging textile in zigzag. The device comprises a frame in which two elevators 15 and 17 can move up and down, wherein the second elevator 17 is not shown in Figure 1. In the frame 7 of the device, which is constructed almost like a tower, there is a zigzag stack 20 consisting of about 30 to 50 layers. The stack 20 extends into the upper portion of the device 100 and ends a few millimeters below two rollers 10, 10', which have a roller gap 8 that is about as thick as the web but which, however, are engaged with each other by means of parts that will be explained later.

The two rollers 10, 10' are driven in exactly the same angular velocity but in opposite directions by an electric motor (not shown) and a synchromesh gear. The vertically hanging transported web 1 is introduced into the roller gap 8 and transported by the rollers 10, 10' in a manner that will be explained later. The web 1 is transported by means of drawing rollers 9 under low tensile stress and taken from a supply (not shown).

The web is provided in a folded manner and in great length in a plurality of stacks in one box. Despite that, the web has to be interrupted after a certain web length. For this purpose, a cutting device 16, which can cut the web 1 in a known manner by means of two cutting knives 16.1 and 16.2, is provided.

Figures 2a to 2c show three phases of laying down the web in zigzag, which can be carried out by means of the device 100 according to the present invention. In Figures 2 and 3 the cutting device was omitted. The web 1 drawn via the drawing rollers 9 reaches the gap 8 between the two rollers 10, 10'. The web 1, which is plane when arriving, has already been gripped by a gripping opening 12 extending in a groove in the roller 10 and transported by the gap 8 to a position A1, which required a distance covered by an angular movement of about 60°. The web lays down on the curved roller surface 5 and moves with the same rotating velocity vector Ω. At this point A1 the gripping opening is opened by a corresponding control command, and the web 1 falls down from the curved surface 5.

Opposite to the opening 12 there is a projection 3' which, when the rollers 10, 10' are correspondingly rotated, engages as a stuffing element into the axis-parallel groove 4 containing the gripping opening 12 and forces the web 1 into the gripping opening 12. Staggered by 180°, the two rollers are provided similarly with the parts 12, 12' and 3, 3'

Figure 2b shows the next phase of laying down the web. In the gap 8, the web 1 is forced by the projection 3 into the axis-parallel groove 4' of the roller 10' so that it is gripped by the corresponding gripper 12' and then bent and transported by the roller 10' - in Figure 2b to the right.

Figure 2c shows the further phase after rotation by 120°. The gripper 12' has moved further and drawn away the web. In this position it releases the web 1 so that it can lay down on the stack 20. Upon a further rotation by 60°, the gripping opening 12 of the roller 10 again takes up the web 1 and guides it to the left side of the stack 20 (as shown in the Figure). Then the state according to Figure 2a has been reached.

The pendulum motion of the web 1 takes place in fractions of a second. In our experience there are no complications. The growing stack is scanned and counted by means of a counter operating with an optical sensor 13. In order to avoid that the stack grows too much in the direction of the two rollers 10, 10', the support of the stack, i.e. the elevator, is moved downwards in accordance with the growing number of layers in the stack.

Figure 7 schematically shows the function of the gripping opening 12 and the projection 3'.

The gripping opening 12 consists of a rigid jaw 36 being firmly connected to the roller 10 and a movable jaw 37 forming the bent end of a lever 38 which rotates together with the roller 10 and which can move around a center of motion 39 in a pendulum manner. The end

of the lever 38 opposite the movable jaw is provided with a feed roller 40.1, which rolls on a centrically rigidly arranged cam disk 40 during the rotation of the roller 10. In accordance with the cams of the cam disk 40, the gripping opening 12, which is formed by the rigid and movable jaws 36 and 37, opens and closes.

The roller 10' opposite the roller 10 has a groove 42; a foldable knife 43 whose front end is formed as a projection 3' is resiliently received in the groove. For this purpose, the foldable knife 43 is connected to an overhung torsional spring 44, which aligns the spring exactly with the gripping opening but nevertheless allows a movement of the web 3' to a required extent. As already indicated, each roller comprises a pair of the two elements gripping opening and web.

Figures 3a to 3c and 4a to 4c show the function of the elements designated as elevators 15 and 17. As shown in Figures 4a to 4c, at the beginning of the stacking process, only the first elevator 15 operates. The elevator 15 consists of an L-shaped prong holder whose freely projecting lower prongs 14 extend along the entire width of the stack 20. The growing of the stack 20 is compensated by a slow downward movement of the elevator 15.

For the continuous stack changing process, which will be described in the following, the rollers 10, 10' have deep peripheral grooves 18 (cf. Figure 6). As can be taken from the previous description, more than 120° of the curve length of the roller 10 are never covered by a web. The largest part of the roller 10 can thus be reached from outside. This possibility is used in order to be able to move the prongs 14 of an elevator 15 or 17 into the grooves 18. The roller 10 has grooves 18, so that a movement into the periphery of the roller 10' is also possible. Basically also the second roller 10' can have grooves 18.

Figure 3a shows the phase shortly before changing the stack. The first elevator 15 is still in the lowest point of the stack (here only shown with three layers). The prongs of the second elevator 17 have moved close to the release point A1. As soon as the web 1 is released from the release point A1, i.e. the gripping opening 12, the elevator 17 moves further towards the web. The web, which is drawn towards the second release point A2 of the roller 10', forms a V-shaped opening into which the prongs 14 move.

By a further movement towards the stack and a further movement towards the right, the web is pressed slightly towards the right in its V-shaped opening, and on the prong a new support for a newly growing stack is provided. As shown in Figure 4c, the first elevator 15 now moves out of its original position. The stack remains in a cardboard box 19 and is

transported towards the right in accordance with Figures 4a, b and c. Four stacks 20, 40, 60, 80 can be stacked in a box 19. Only with the fourth stack is the capacity of the box 19 exhausted. The web 1 is cut and a new stack is grown. The ends of the web are drawn over the edge of the box and can be connected so that a continuous removal is possible.

Thus, there are two repeating process steps which are connected in a pendulum process.

The arriving web 1 is gripped and put against one of two opposite curved surfaces, i.e. the rotating rollers whose axes are parallel to the web surface and, after having covered a distance corresponding to about half the zigzag layer distance, it is released and laid down on the stack 20. Shortly before or after or simultaneously with the first step, the web is gripped again in the roller gap 8 in the zigzag layer distance and put against the second roller 10' and, after having covered a distance corresponding to about half the zigzag layer distance and wherein the movement is opposite to the movement of the first web portion, it is released and laid down on the stack 20. The two rollers and the corresponding web portion contact each other and move with the same rotating velocity vector Ω. The web 1 is gripped by means of grippers 12, 12' with the aid of movable projections 3, 3' which are rigidly connected with the curved surfaces, i.e. the rollers 10, 10'. The web 1 is gripped vertically with respect to the movement direction of the planely extending web.

In contrast to the present embodiment, the device can also be arranged such that the web arrives horizontally and the zigzag layers are pressed against a stacking surface and then transported away. In this regard, claim 1 should not be limited to the shown embodiment. It is also possible to stack narrow bands in that they are laid down on a plate in an ornamental pattern, thereby contacting the plate laterally. After a first layer has been laid down as a plane formation, a second layer can then be laid on the first layer so that a "stack consisting of stacks" can be formed.

Moreover, in contrast to the present embodiments, also a polished, non-moving pair of rollers can be used, wherein grippers extend through the periphery of the roller and carry out a movement corresponding to a pendulum movement.

The scope of protection of claim 1 thus does not only extend to rotating but also to non-moving rollers with corresponding holding and release devices. In principle, no rotation of the gripping devices is necessary, either, but it is sufficient if a pendulum movement with corresponding transporting function is performed. In this connection, also non-cylindrical

rollers can be used. Also smooth surfaces forming an angle with respect to the surface of the web allow the guidance of a web as characterized in claim 1.

Figure 5 shows an arrangement of a plurality of devices 100 which are arranged in the form of a cascade and displaced with respect to one another, and which are allocated to a wound-up web 1 which is kept tight by dancing or compensating rollers 21 and cut by means of slit knives 23 into individual narrow webs 1, 1', each of which is supplied to a device 100. Thus, large amounts of webs consisting of a nonwoven fabric, a textile or a plastic film can be laid down in zigzag. The individual stacks 20, 40 are transported away and supplied to a conveyor belt which is schematically shown on the left-hand side of Figure 5 (reference numeral 25).

Claims

1. A process for folding and laying down a flexible web (1) consisting of a nonwoven fabric, a textile or a plastic film in zigzag, wherein the arriving web is contacted according to the zigzag layer distances, a corresponding portion thereof is bent and then laid down in a stack (20), characterized by the following process steps:
   (a) the web, which is plane when arriving, is gripped and put against one of two opposite curved surfaces (5, 5') or surfaces (5, 5') forming an angle with respect to the arriving web, the axis of said surfaces being parallel to the web surface, and, after having covered a distance which corresponds to about half the zigzag layer distance, it is released and laid down on the stack (20),
   (b) at the end of the first step, the web is again gripped at the zigzag layer distance and put against the second one of the two opposite curved surfaces (5, 5') or surfaces (5, 5') forming an angle with respect to the arriving web and, after having covered a distance which corresponds to about half the zigzag layer distance and wherein the movement is opposite to the movement in the first step, it is released and laid down on the stack (20).

2. The process according to claim 1, characterized in that the curved surfaces (5, 5') and the corresponding web portion contact each other and move with the same rotating velocity vector.

3. The process according to claim 1 or 2, characterized in that the web is gripped by means of movable grippers and that the curved surfaces do not move.

4. The process according to claim 1 or 2, characterized in that the curved surfaces rotate and that the web is gripped by means of grippers (12, 12') being rigidly connected with the curved surfaces.

5. The process according to at least one of the preceding claims, characterized in that the web is gripped vertically with respect to the movement direction of the planely extending web (1).

6. The process according to at least one of the preceding claims, characterized in that after a predetermined number of zigzag layers has been laid down, a stack (20) is moved and a new stacking process starts without interrupting the web (1).

7. A device for carrying out the process according to claim 1 and optionally further dependent claims, characterized in that the curved surfaces (5, 5'), to which the web (1) alternately adheres, are formed by bodies (rollers 10, 10') which do not move or rotate in opposite directions.

8. The device according to claim 7, characterized in that the bodies which rotate in opposite directions perform continuous or pendulum rotational movements.

9. The device according to claim 7 or 8, characterized in that the bodies are rollers (10, 10') at the periphery of which at least one controlled gripper (12, 12') is arranged.

10. The device according to claim 9, characterized in that the gripper consists of a gripping opening (12, 12') which is arranged in an axis-parallel groove and which does not project from the periphery of the circumference of the gripper roller (10, 10').

11. The device according to claim 10, characterized in that the roller opposite to the gripper roller has a projection (3, 3') which, upon a respective rotation of the rollers, engages into the axis-parallel groove as a stuffing element and forces the web (1) into the gripping opening (12, 12').

12. The device according to claim 11, characterized in that the rotating rollers (10, 10') comprise a groove (4, 4') and a projection (3, 3') being spaced at an angle of rotation of 180° and being arranged in an opposite manner at the circumference.

13. The device according to at least one of claims 9 to 12, characterized in that the stack (20) is laid down from the top to the bottom on an elevator (15, 17) which is adjustable as regards its height.

14. The device according to claim 13, characterized in that the support surface of the elevator (15, 17) consists of individual prongs (14) and that at least one of the rollers has a circumference (11) having peripheral grooves (18) into which the prongs (14) of the elevator can engage and disengage.

15. The device according to claim 13 or 14, characterized in that two elevators (15, 17) are provided which alternately serve as a stacking surface.

16. The device according to claim 15, characterized in that the two elevators (15, 17) comprise prongs (14) being arranged at different distances from each other so that a stack can be changed when the prongs are interconnected.